

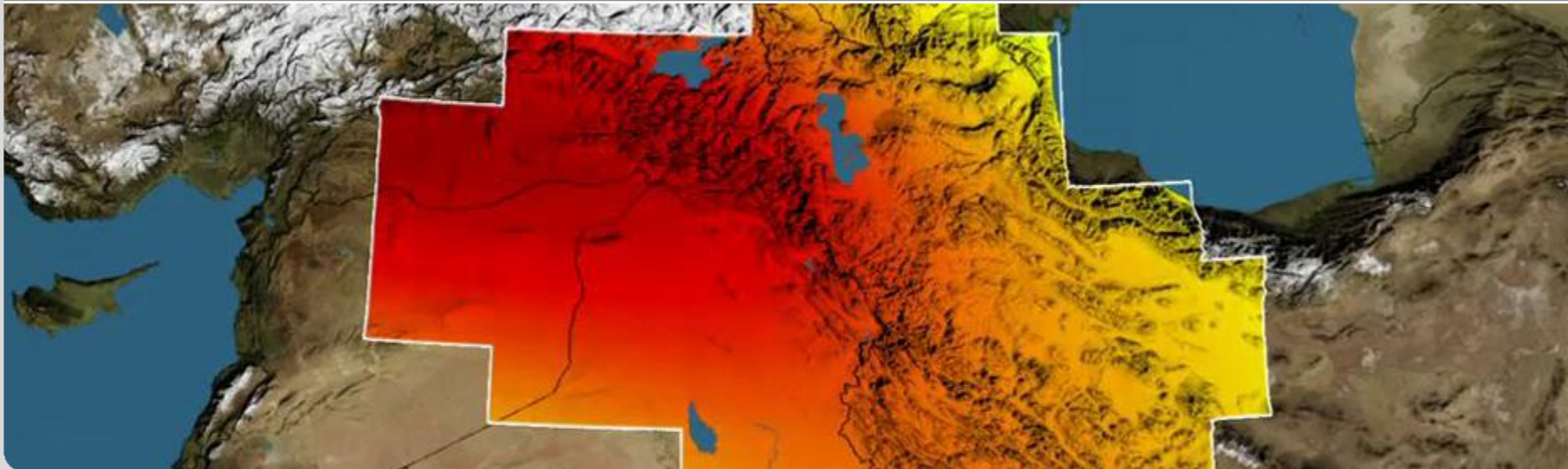
SMART Research using Linked Data – Sharing Research Data for Integrated Water Resources Management in the Lower Jordan Valley

Benedikt Kämpgen, David Riepl, Jochen Klinger

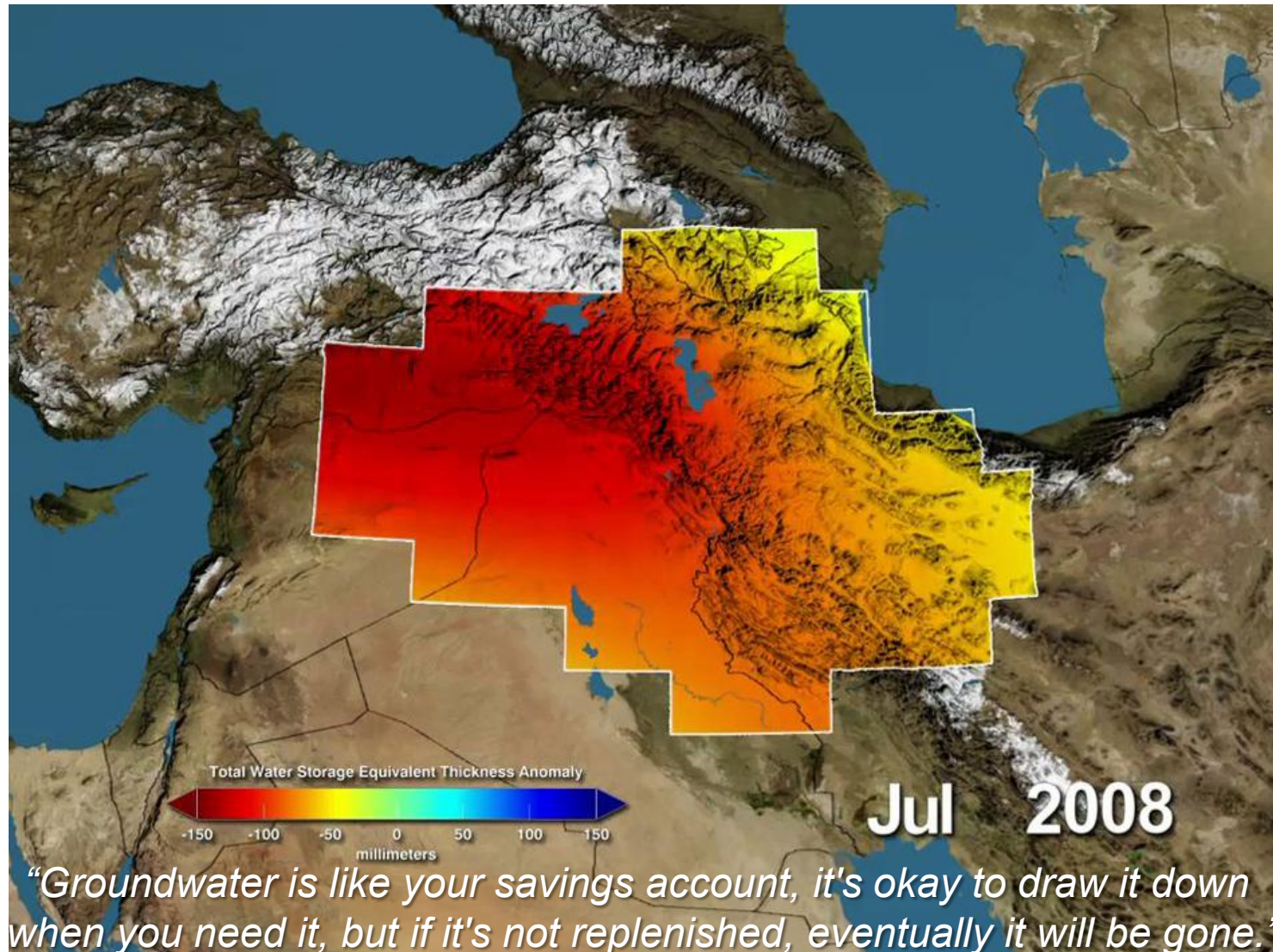
Sepublica 2014

May 25 2014

Institute of Applied Informatics and Formal Description Methods (AIFB)

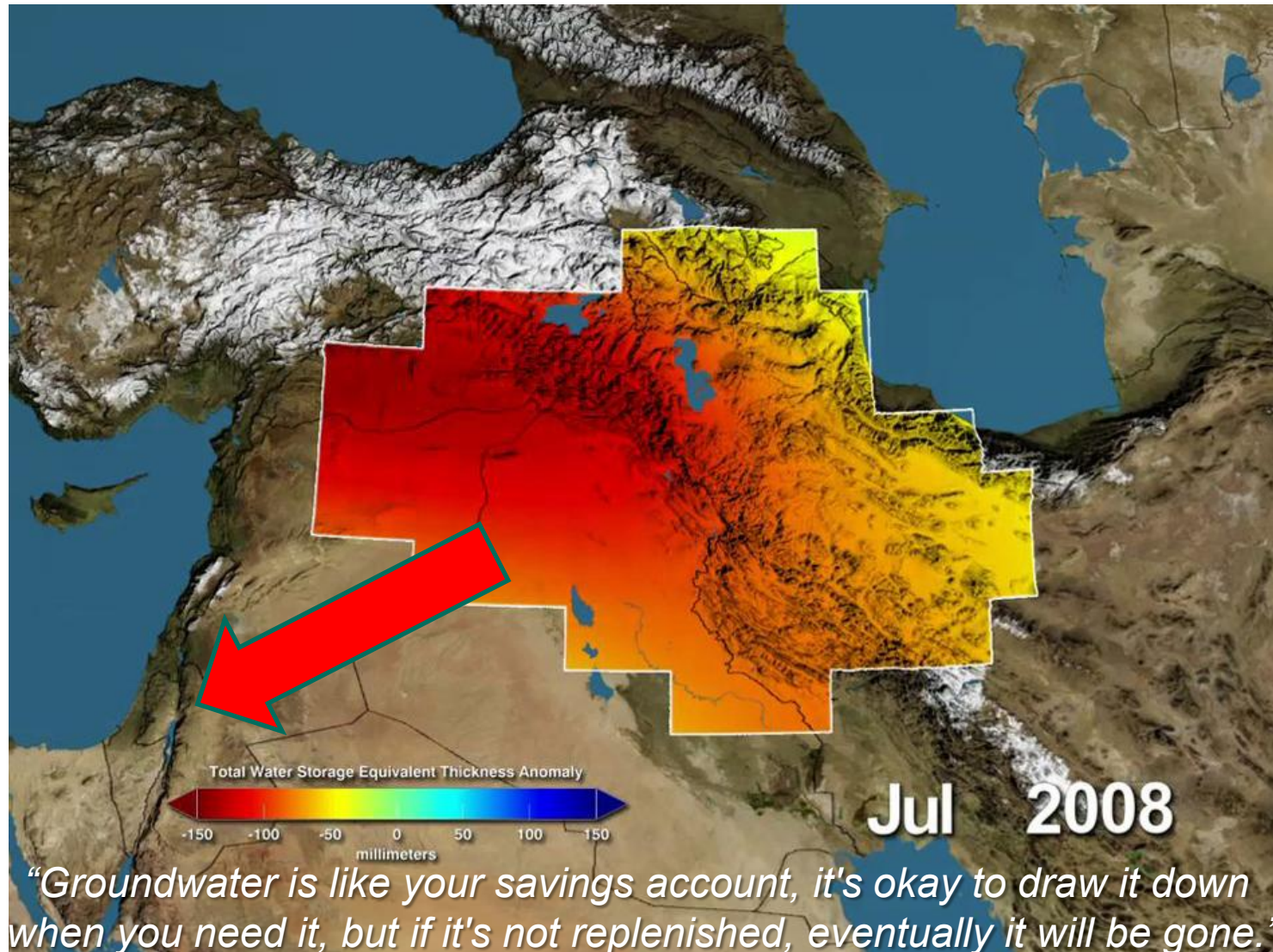


Pressure and competition on natural freshwater resources



<http://politics.slashdot.org/story/13/02/13/1731237/nasa-huge-freshwater-loss-in-the-middle-east>

Pressure and competition on natural freshwater resources



<http://politics.slashdot.org/story/13/02/13/1731237/nasa-huge-freshwater-loss-in-the-middle-east>

Integrated Water Resources Management (IWRM)

■ Example: Jordanian Water Strategy

Objective	Implementation
Social	<i>Decrease the leakages from sewer pipes in As Salt, Fuheis and Mahis</i>
Economical	<i>Improve meter reading and billing accuracy to reduce administrative losses</i>
Ecological	<i>Implementation of Spring Protection Zones for Azraq, Baqourria, Hazzir and Shorea Springs</i>

Outline

- Water Scarcity in the Lower Jordan Valley
- **Challenges of IWRM**
- SMART Knowledge Base Approach
- IWRM Process for Wadi Shueib
- Lessons Learned
- Related Work
- Conclusions

IWRM (Multi-Criteria) Decision Problem

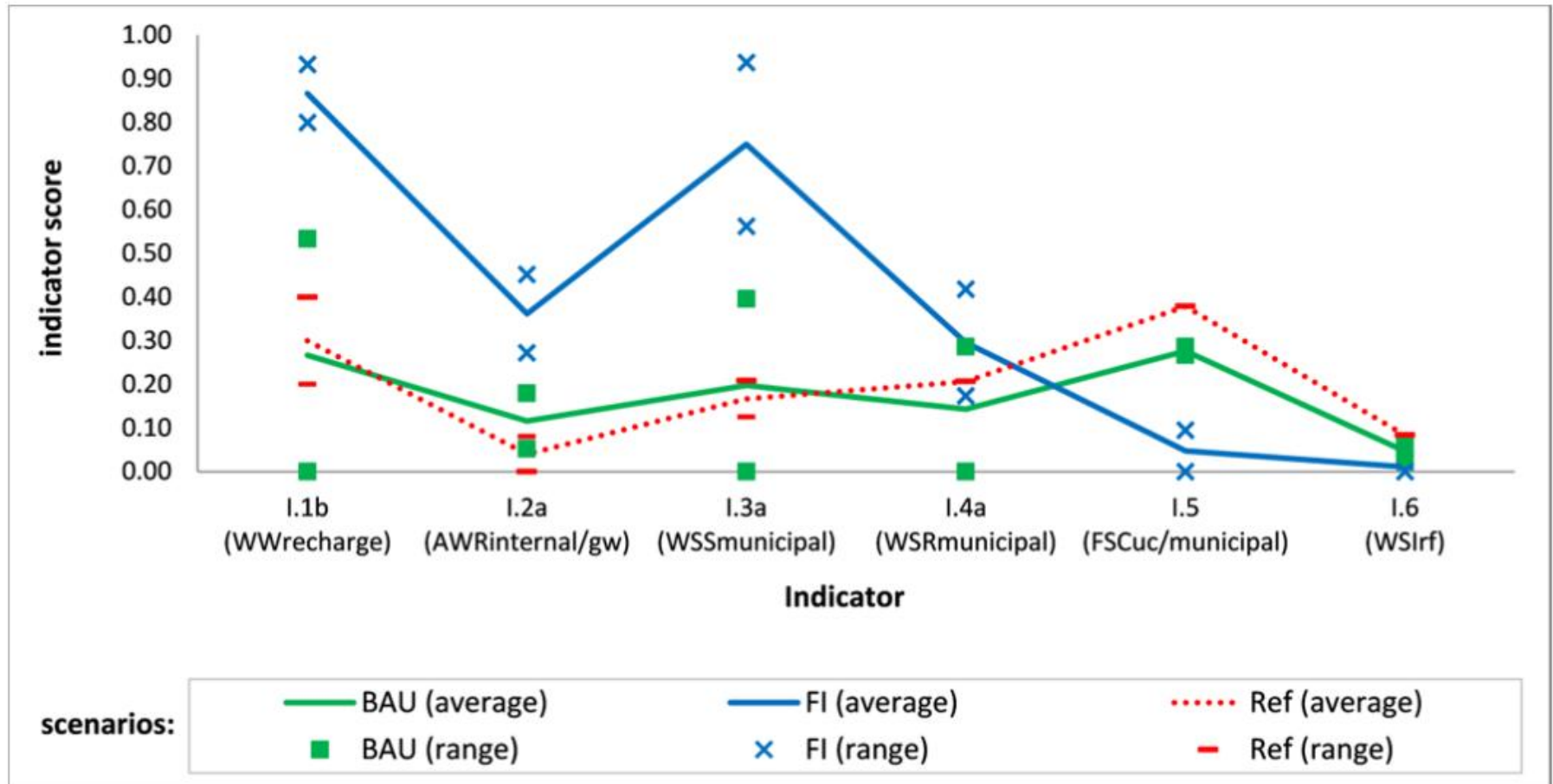


Illustration of IWRM process result: decision matrix with normalised indicators values for scenarios in Wadi Shueib in 2025

IWRM (Multi-Criteria) Decision Problem

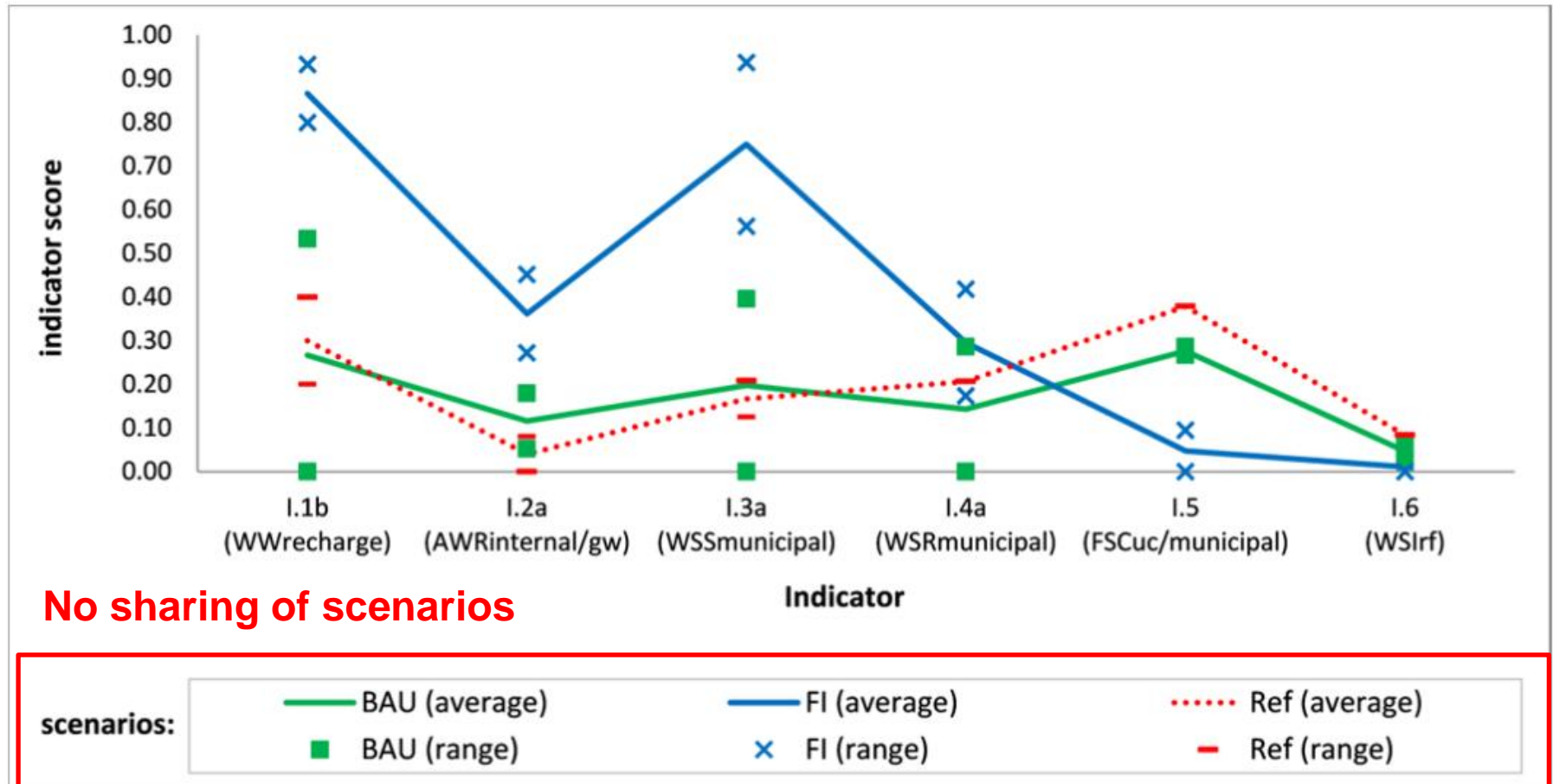


Illustration of IWRM process result: decision matrix with normalised indicators values for scenarios in Wadi Shueib in 2025

IWRM (Multi-Criteria) Decision Problem

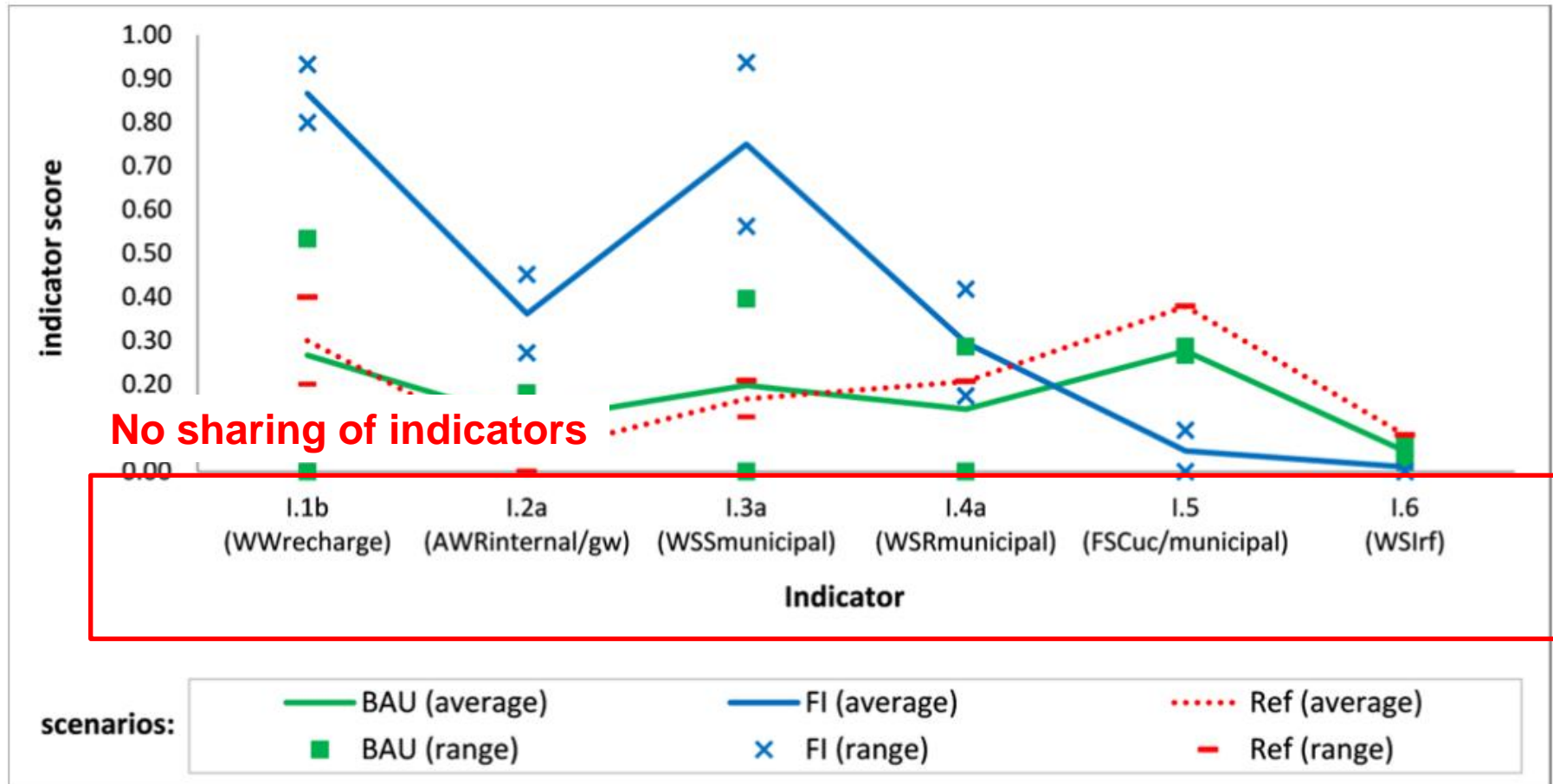


Illustration of IWRM process result: decision matrix with normalised indicators values for scenarios in Wadi Shueib in 2025

IWRM (Multi-Criteria) Decision Problem

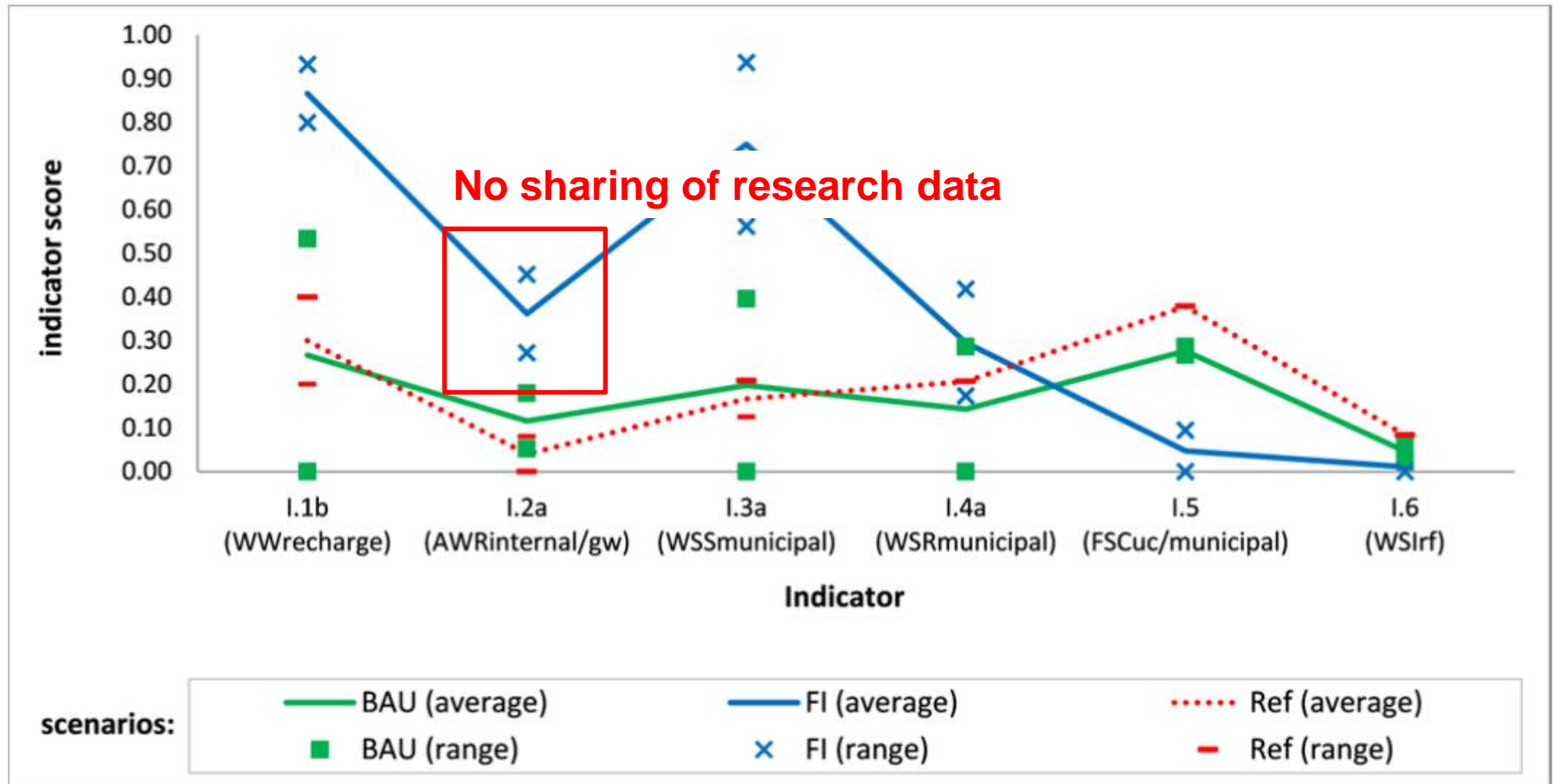
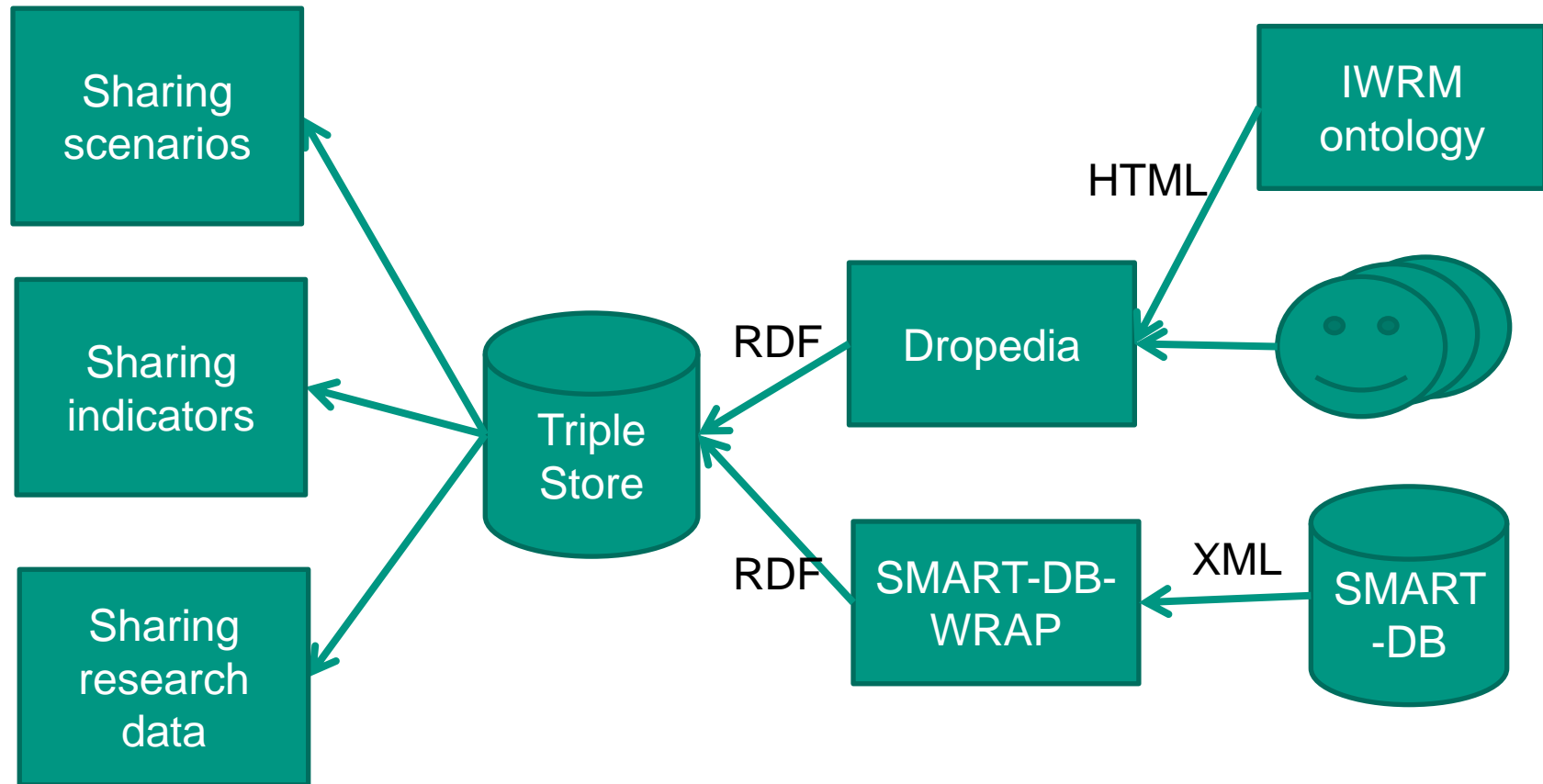


Illustration of IWRM process result: decision matrix with normalised indicators values for scenarios in Wadi Shueib in 2025

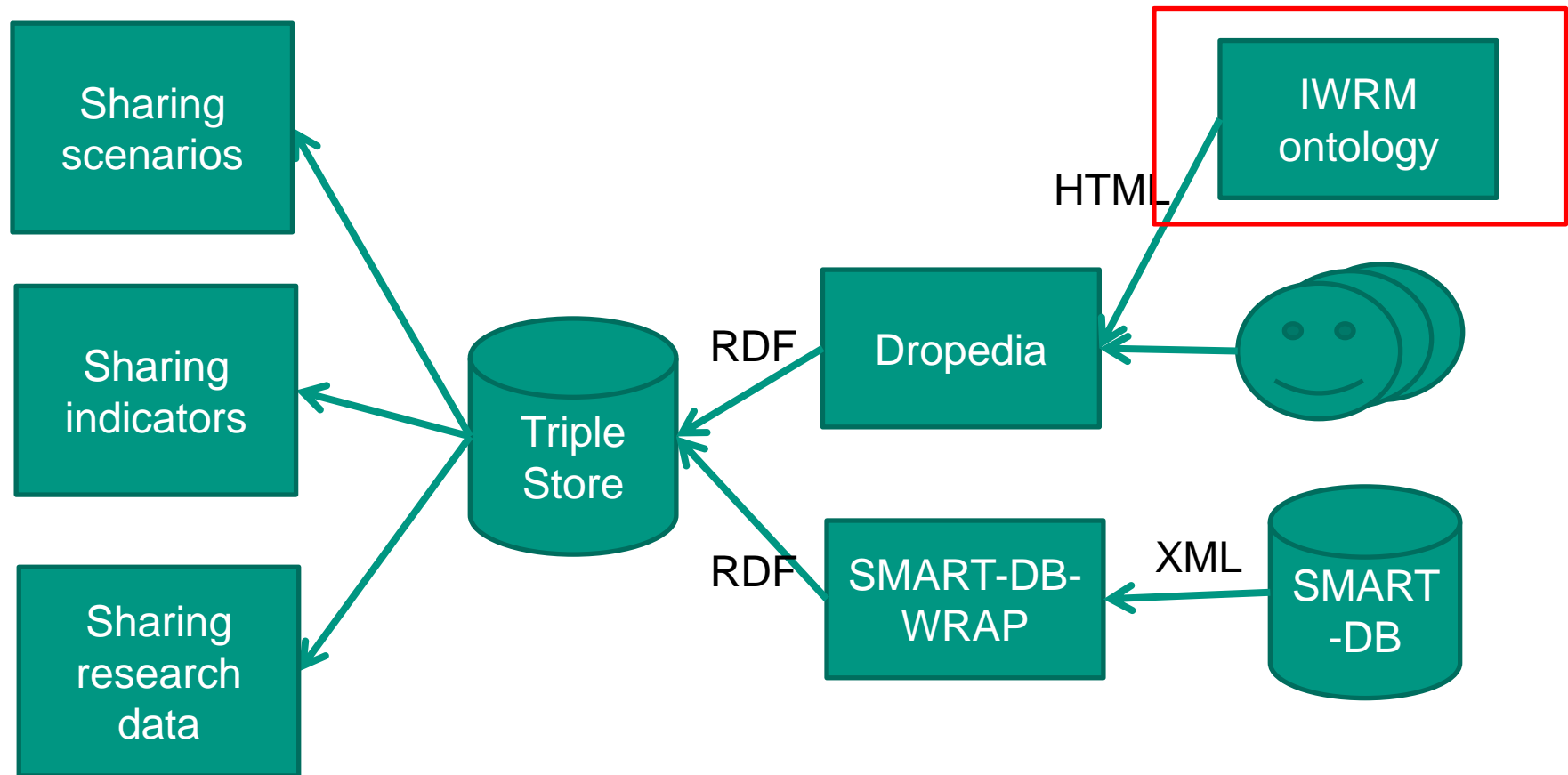
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SMART Knowledge Base Approach

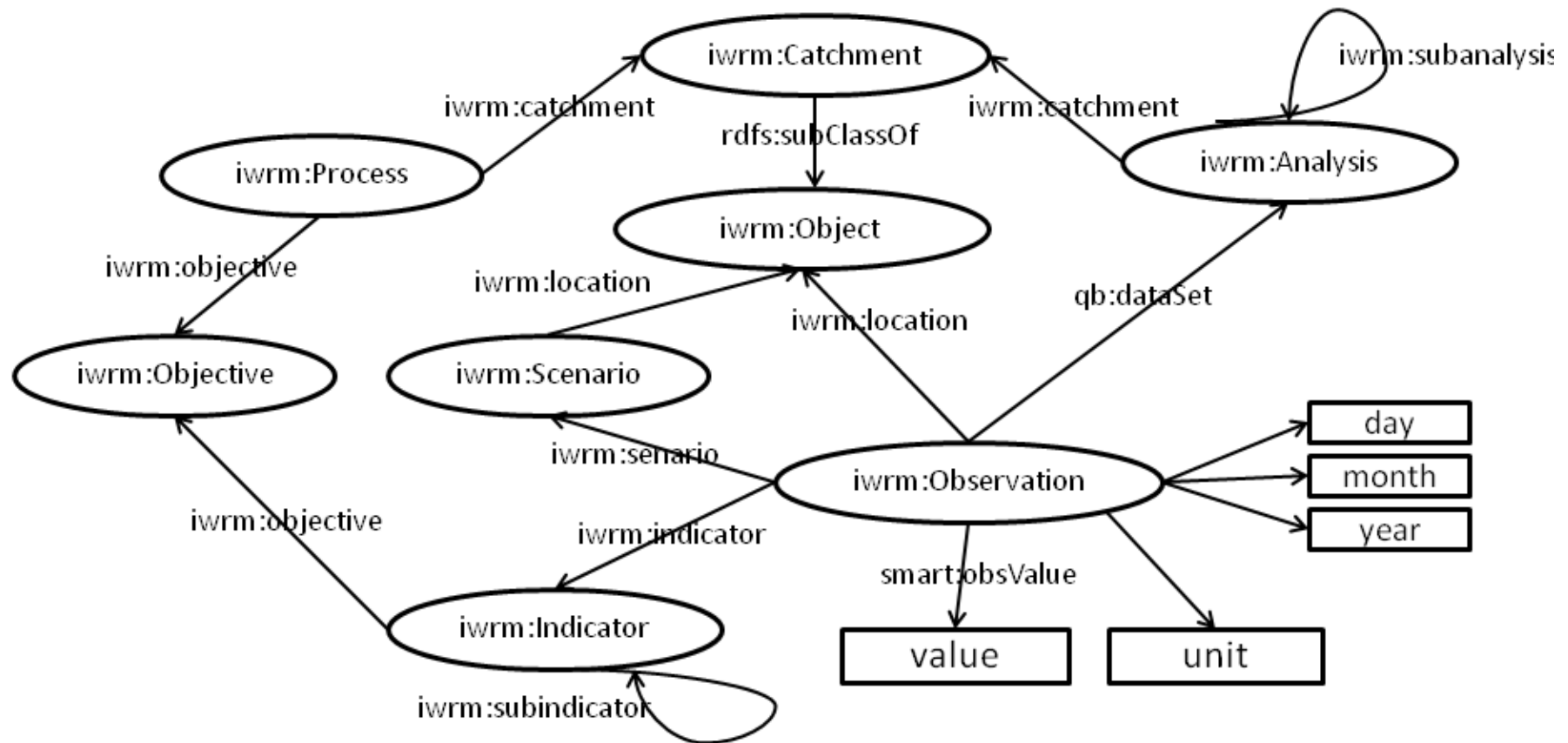


SMART Knowledge Base Approach



Formalising the IWRM Domain

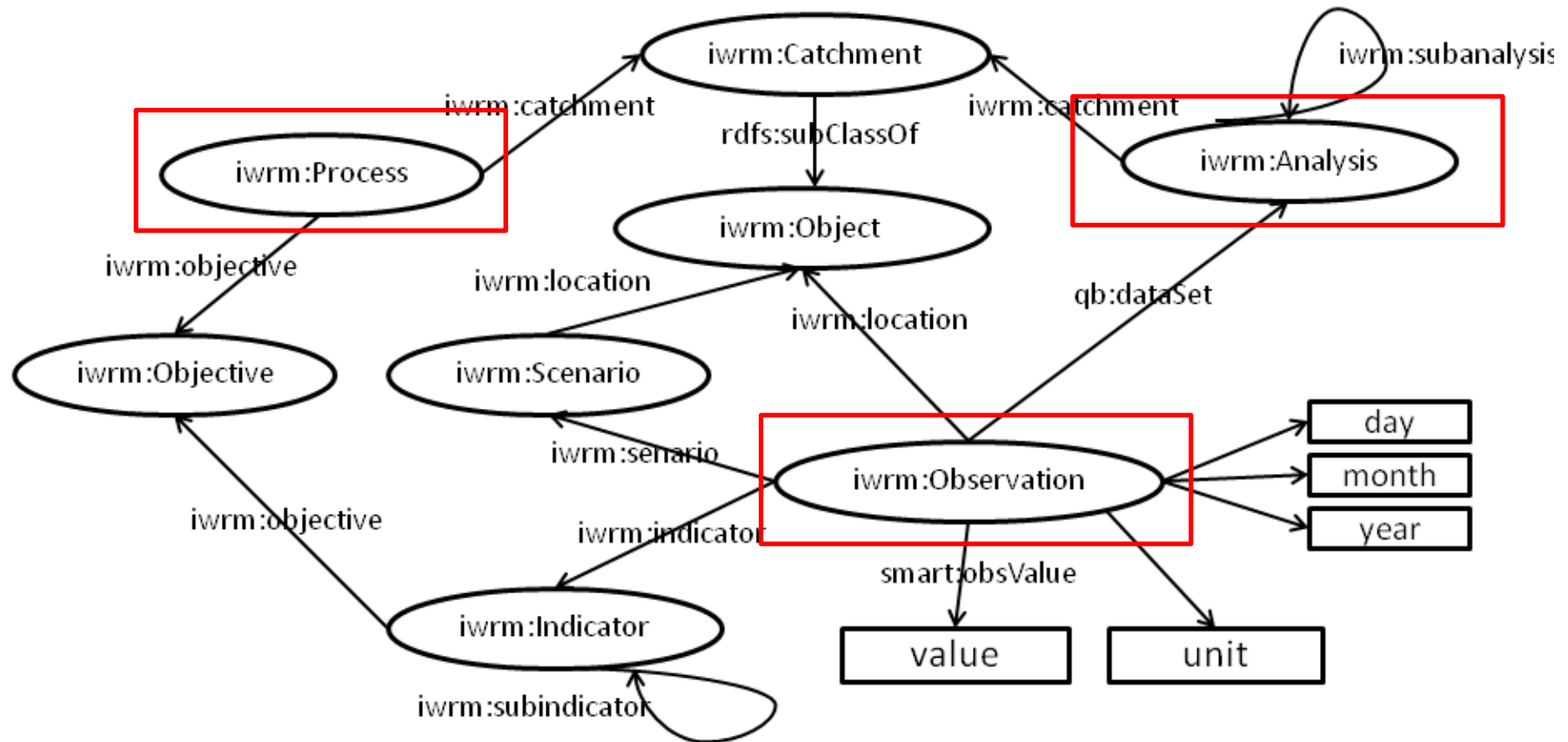
IWRM Ontology



High-level overview of IWRM domain using RDF Data Cube Vocabulary for modelling research data

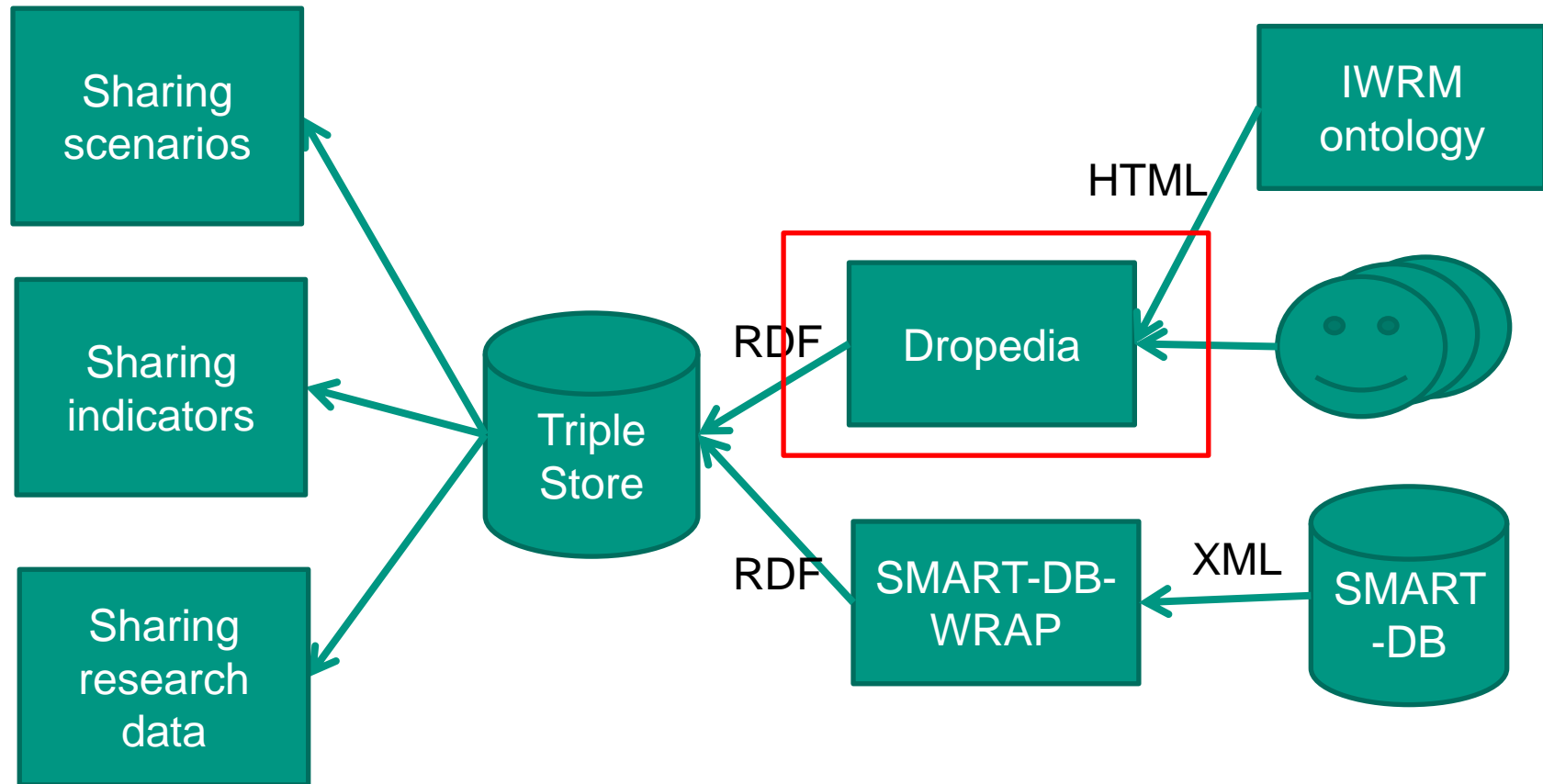
Formalising the IWRM Domain

IWRM Ontology



High-level overview of IWRM domain using RDF Data Cube Vocabulary for modelling research results

SMART Knowledge Base Approach



Collaborative Modelling Dropedia

← dropedia.iwrm-smart2.org/index.php/Special:FormEdit/Catchment2/Wadi_Shueib



special page

Add/edit geography and meta-infos and upload files: Wadi Shueib

General Info

Geography	
Name	<input type="text" value="Wadi Shueib,Wadi Shuayb, Wadi Shoaib, Wadi Shu'aib"/> <small>(Multiple entries seperated by ",")</small>
ID-Code	<input type="text" value="AM"/> System: <input type="text" value="MWI"/>
(Super-)Catchment	<input type="text" value="Lower Jordan River Basin"/>
Region	<input type="text" value="Al Balqa Governorate"/>
Country	<input type="text" value="Jordan"/>
Area [km²]	<input type="text" value="198 km²"/>
Kml-File	<input type="text" value="File:Wadi Shueib catchment boundary.kmz"/> Upload file
Author	<input type="text" value="David Riepl"/>
Major Contribution	<input type="text" value="Leif Wolf"/>

Map

Enter Geographic Coordinates manually or pick



New Palestine Grid Coordinates:

<http://dropedia.iwrm-smart2.org/>

search

general knowledge

- Knowledge browser
- IWRM processes
- SMART project

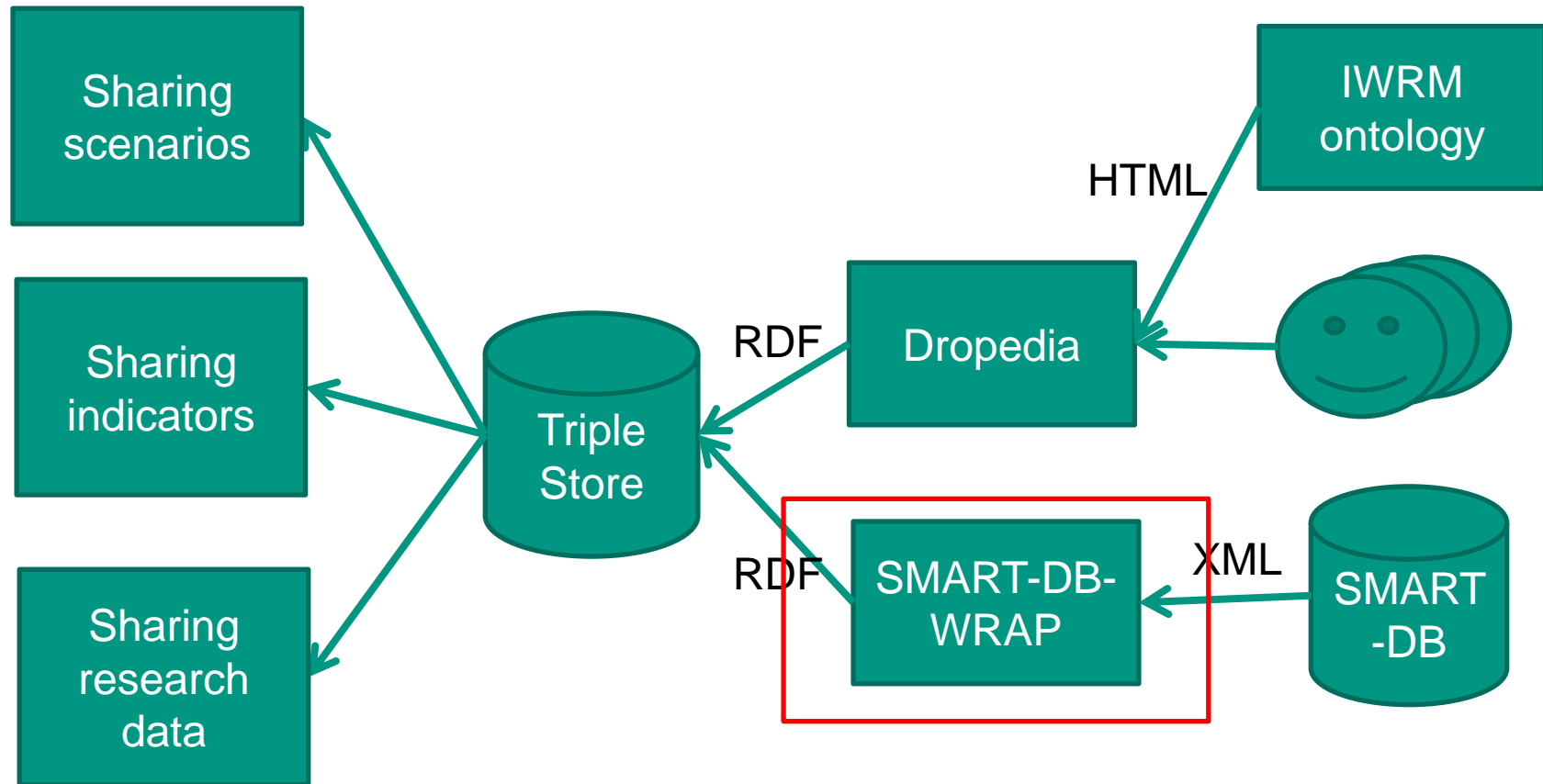
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SMART Knowledge Base Approach



Allow integration of climate data

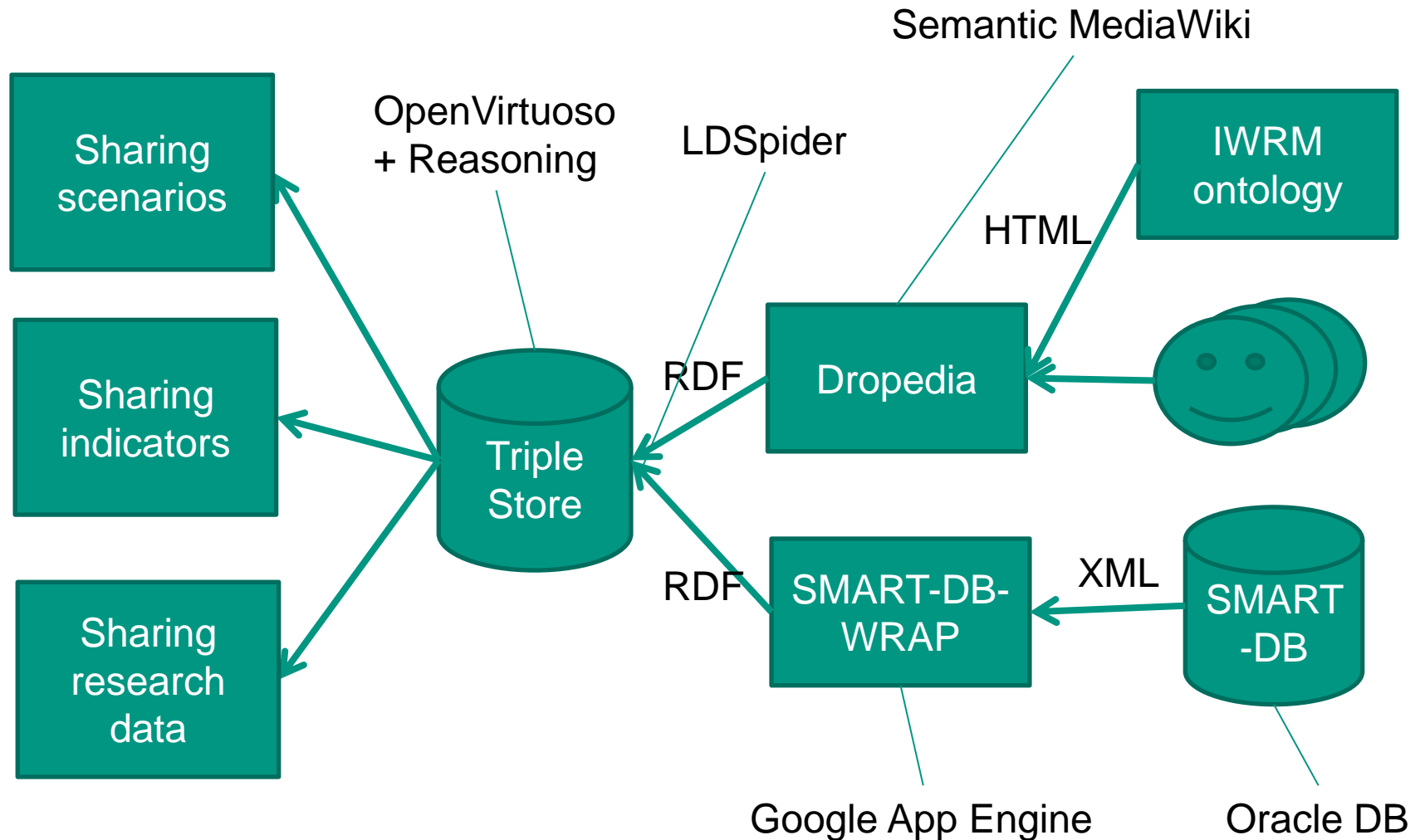
SMART-DB-WRAP

■ Wrapping SMART-DB (Oracle DB) as Linked Data

Object	URI
Wadi Shueib as referred to in Dropedia	<code>dropedia:Wadi_Shueib</code>
Shorea Spring as referred to in Dropedia	<code>dropedia:Shorea_Spring</code>
Shorea Spring as referred to in SMART-DB ⁹	<code>smart-db:/id/location/AM0528</code>
Average Discharge in Dropedia	<code>dropedia:Annual_Average_Discharge</code>
Average Discharge from SMART-DB	<code>smart-db:/id/analysisobject/Q</code>
Dataset of locations from SMART-DB	<code>smart-db:/id/location/ds</code>
Dataset of indicators from SMART-DB	<code>smart-db:/id/analysisobject/ds</code>
Dataset of Mean Discharge for Shorea Spring from SMART-DB	<code>smart-db:/id/location-dataset/AM0528/Q</code>

<http://smartdbwrap.appspot.com/>

SMART Knowledge Base Approach

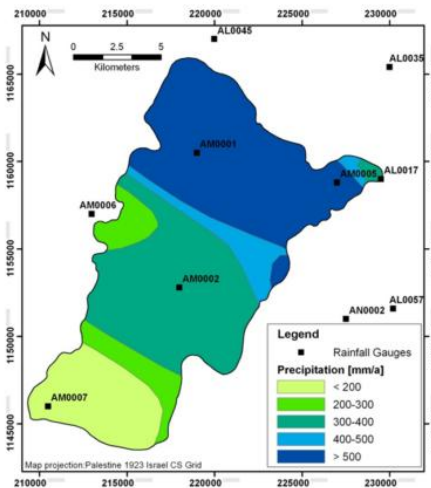


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IWRM Process for Wadi Shueib

- [Riepl, 2013]
 - 6 IWRM processes, 7 objectives, 22 indicators, 22 scenarios and 27 analyses are described in Dropedia
- Setup
 - AMD Athlon(tm) 64 Processor 3000+ with 2G memory with Ubuntu Linux



Metadata shared over Dropedia Shorea Spring Overview

dropedia.iwrm-smart2.org/index.php/Shorea_Spring

brackish water

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Shorea Spring

Spring

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- 1 Spring
- 2 Discharge-Timeseries
- 3 Attached Files
 - 3.1 SMART-DB Analyses
- 4 General Description
- 5 Water Discharge
- 6 Water Quality
- 7 Water Production
- 8 Resource Protection
- 9 Economy
- 10 Other Information

Add/edit Spring Metadata

Geography	
Name	Shorea Spring, Shorea, Shore'ai', Shoreya'a
ID-Code (MWI-WIS ⚠)	AM0528
Catchment	Wadi Shueib
Region	Al Balqa
Country	Jordan
Altitude [m] asl	595 m
Aquifer:	A7
Spring type:	Contact Spring
Water type (salinity):	Freshwater
Discharges to	
Monitored Parameter(s):	Discharge

Authors	
Author(s)	
Major Contribution	

Map



Geographic Coordinates: 32° 0' 36" N, 35° 44' 24" E

NPG Coordinates 219520 E, 1158401 N

Discharge-Timeseries

SMART-DB climate data integrated Shorea Spring Discharge

dropedia.iwrm-smart2.org/index.php/Shorea_Spring

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Shorea Spring

Spring

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[hide]

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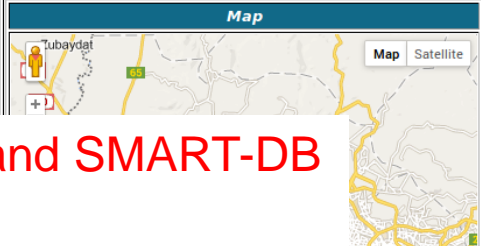
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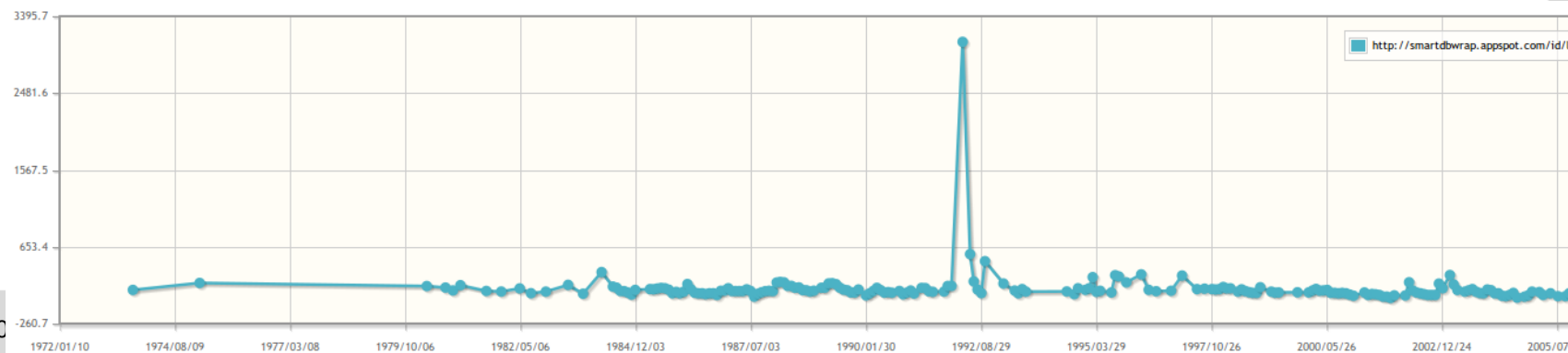
Map



Geographic Coordinates: 32° 0' 36" N, 35° 44' 24" E
NPG Coordinates 219520 E, 1158401 N

Links between Dropedia and SMART-DB
(Equivalence Statements)

Discharge-Timeseries



Scenarios/indicators/research data shared


Shorea Spring Discharge Estimation

← → agkwebserver2.agk.uni-karlsruhe.de/~dropedia/index.php/Shorea_Spring_10-year_average_discharge ☆ Google

Bkaempgen my talk my preferences my watchlist

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Shorea Spring 10-year average discharge



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toolbox

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Edit/Comment Analysis


Smart:analysis Object	Smart:day	Smart:obsValue	Smart:analysis Unit	Smart:location	Comment	Scenario
Average Annual Discharge	http://reference.data.gov.uk/id/day/1995-12-31	143.8	m³/h	Shorea Spring	based on 10-year monthly measurements	Status Quo
Average Annual Discharge	http://reference.data.gov.uk/id/day/2005-12-31	143.8	m³/h	Shorea Spring	based on 10-year monthly measurements	Status Quo
Average Annual Discharge	http://reference.data.gov.uk/id/day/2010-12-31	143.8	m³/h	Shorea Spring	based on 10-year monthly measurements	Status Quo

Add/edit property value


Research and climate data can be explored

Shorea Spring Discharge Over Time


Cubes


dropedia:SMART-2DDB-2DDSD

Dimensions


▼  smartdbwrap:analysis_Object


- smartdbwrap:analysis_Object

▶  smartdbwrap:analysis_Unit

▼  smartdbwrap:location


- smartdbwrap:location

▶  smartdbwrap:month













▼  smartdbwrap:year

- smartdbwrap:year

Measures

▼  Measures

- smartdbwrap:obsValue AVG
- smartdbwrap:obsValue COUNT



Columns

smartdbwrap:obsValue AVG ▾ smartdbwrap:obsValue COUNT ▾

Rows

smartdbwrap:year ▾ 🔍


Filter


smartdbwrap:location ▾ 🔍 smartdbwrap:analysis_Object ▾ 🔍

smartdbwrap:year	smartdbwrap:obsValue AVG	smartdbwrap:obsValue COUNT
refgovukyear:1973	140	1
refgovukyear:1983	147.5	2
refgovukyear:1993	143.8	5
refgovukyear:2003	155.2	10
refgovukyear:2004	89.545454545454545	11
refgovukyear:2005	98.777777777777778	9
refgovukyear:2006	103.333333333333333	6
refgovukyear:2010	144	1


Research and climate data can be explored

Shorea Spring Discharge Over Time


Cubes


dropedia:SMART-2DDB-2DDSD

Dimensions


▼  smartdbwrap:analysis_Object


- smartdbwrap:analysis_Object

▶  smartdbwrap:analysis_Unit

▼  smartdbwrap:location


- smartdbwrap:location

▶  smartdbwrap:month













▼  smartdbwrap:year

- smartdbwrap:year


Measures


▼  Measures

- smartdbwrap:obsValue AVG
- smartdbwrap:obsValue COUNT





Columns



smartdbwrap:obsValue AVG 



smartdbwrap:obsValue COUNT 

Rows

smartdbwrap:year  

Filter

smartdbwrap:location  

smartdbwrap:analysis_Object  

smartdbwrap:year	smartdbwrap:obsValue AVG	smartdbwrap:obsValue COUNT
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refgovukyear:1983	147.5	2
refgovukyear:1993	143.8	5
refgovukyear:2003	155.2	10
refgovukyear:2004	89.545454545454545	11
refgovukyear:2005	98.777777777777778	9
refgovukyear:2006	103.333333333333333	6
refgovukyear:2010	144	1

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Lessons Learned

■ Proof-of-concept

- Sharing scenarios and indicators
- Application over integrated research and raw data

■ Challenges

- Complex Modelling (e.g., Wastewater Recharge Ratio)
- Usability and Training (e.g., culture of two-way sharing)

■ Opportunity

- Open Data trend (DataCite, FigShare, Pangea...)
- Easier integration of new data sources by
 - ... Linked Data Wrappers
 - ... Equivalence statements

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Related Work

	Decision Support	Collaboration	Publication	Integration
GIS / DSS Tools (WEAP...)	+			
Wikis (WaterWiki...)		+		
Data Portals (CUASHI...)			+	
Semantic Approaches (Curators...)			+	+
SMART Knowledge Base	(+)	+	+	+

Conclusions

- Sharing of **scenarios and indicators** possible
- **Benefit** with applications over integrated data
- **New data sources** promise more benefits
- **Easier integration** with SW technologies

- Scientists from Jordan, Palestine, Israel talking about Open Data

- Current work: Collecting Open Data Best Practices: Share-PSI 2.0

<http://www.w3.org/2013/share-psi/>

Thanks!

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References

- [UNEP/GRID-Arendal] (2008). Areas of physical and economic water scarcity.: UNEP/GRID-Arendal Maps and Graphics Library.
- [Riepl, 2013] Riepl, D.: Knowledge-Based Decision Support for Integrated Water Resources Management with an application for Wadi Shueib, Jordan. KIT Scientific Publishing, Karlsruhe (2013)